REMARKS

Claims 1-18 are currently pending in the present application. In the Office Action, Claims 1-18 have been rejected under 35 U.S.C. § 102(e) as being anticipated by *Belaiche* (U.S. 6,501,748 B1). However, it is respectfully submitted that the foreign filing dates of the priority documents of the present invention (June 25, 1999 and July 7, 1999) pre-date the U.S. filing date of *Belaiche*, which is April 20, 2000. As a result, *Belaiche* is not prior art against the present invention.

Further, we have enclosed verified English translations of KPAs 26221/1999 and 27163/1999, as is required under 37 C.F.R. § 1.55.

Accordingly, all of the claims pending in the Application, namely, Claims 1-18, are believed to be in condition for allowance. Should the Examiner believe that a telephone conference or personal interview would facilitate resolution of any remaining matters, the Examiner may contact Applicants' attorney at the number given below.

Respectfully submitted,

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CERTIFICATION FOR TRANSLATION

As a below named translator, I hereby declare that:

My residence and citizenship are as stated below next to my name.

I hereby certify that I am conversant with both the English and Korean languages and the documents enclosed herewith are true English translations of the priority documents with respect to the Korean Patent Application Nos. **26221/1999** filed on **25 June 1999** and **27163/1999** filed on **7 July 1999.**

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[SPECIFICATION]

[TITLE OF THE INVENTION]

APPARATUS AND METHOD FOR CHANNEL CODING AND MULTIPLEXING IN CDMA COMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a block diagram of an embodiment of an uplink channel transmitting device according to the present invention.

FIG. 2 is a block diagram of an embodiment of a downlink channel transmitting device according to the present invention.

FIG. 3 is a view illustrating the operation of the channel transmitting devices shown in FIGS. 1 and 2.

FIG. 4 is a block diagram of an embodiment of a channel receiving device according to the present invention.

FIG. 5 is a flowchart illustrating a radio frame generation procedure using filler bits according to the present invention.

FIG. 6 is a flowchart illustrating a radio frame generation procedure without using filler bits according to the present invention.

FIG. 7 is a flowchart illustrating an embodiment of a radio frame multiplexing procedure according to the present invention.

FIG. 8 is a flowchart illustrating an embodiment of a physical channel frame generation procedure according to the present invention.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT]

[OBJECT OF THE INVENTION]

[RELATED FIELD AND PRIOR ART OF THE INVENTION]

The present invention relates generally to a channel communication apparatus and method in a mobile communication system, and in particular, to a device and method for generating and transmitting a frame.

A conventional CDMA (Code Division Multiple Access) mobile communication system primarily provides a voice service. However, the future CDMA mobile communication system will support the IMT-2000 standard, which can provide a

high-speed data service as well as the voice service. More specifically, the IMT-200 standard can provide a high-quality voice service, a moving picture service, an Internet browsing service, etc. This CDMA communication system is comprised of a downlink for transmitting data from a base station to a mobile station and an uplink for transmitting data from the mobile station to the base station.

The future CDMA communication system should provide various communication services such as simultaneous voice and data communications. However, details are yet to be specified for the simultaneous implementation of voice and data communications.

[SUBSTANTIAL MATTER OF THE INVENTION]

It is, therefore, an object of the present invention to provide a channel communication apparatus and method, which can simultaneously perform various communication services in a CDMA communication system.

It is another object of the present invention to provide an apparatus and method for generating a radio frame and a physical channel frame when performing multiplexing and channel coding operations in a CDMA communication system.

It is further another object of the present invention to provide an apparatus and method for multiplexing a generated frame when performing multiplexing and channel coding operations in a CDMA communication system.

It is still another object of the present invention to provide an uplink channel communication apparatus and method in a CDMA communication system, which can perform various communication functions.

It is yet another object of the present invention to provide a downlink channel communication apparatus and method in a CDMA communication system, which can perform various communication functions.

It is still yet another object of the present invention to provide a channel receiving apparatus and method in a CDMA communication system, which can perform various communication functions.

To achieve the above and other objects, there is provided a channel communication device in a CDMA communication system. The channel communication device comprises: two or more coders for generating coding data having different frame sizes and transmission periods; radio frame generators for dividing a frame outputted from the coders into a plurality of radio frames having a same frame transmission period; a multiplexer for sequentially storing the radio frames outputted from the radio frame generators and generating a multiplexing frame; and a physical channel frame generator for generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

[CONSTRUCTION AND OPERATION OF THE INVENTION]

The present invention defines in detail radio frame segmentation, second multiplexing, and physical channel segmentation for channel coding & multiplexing in a channel communication device of a CDMA communication system. That is, radio frame segmentation, second multiplexing of radio frames, and segmentation of the multiplexed radio frames into physical channel frames, that are not provided by the 3GPP Technical Specification for Multiplexing and Channel Coding, TS 25.212, will be defined fully enough to deal with bit-basis operations.

A description will now be made of the structures and operations of 3GPP uplink and downlink channel coding and multiplexing apparatuses including a first interleaver through a second interleaver according to an embodiment of the present invention.

FIGS. 1 is a diagram illustrating the configuration of an uplink channel transmitting device according to an embodiment of the present invention. Receiving devices for receiving information from the channel transmitting devices have the reverse configurations of their counterparts.

Referring to FIG. 1, reference numeral 100 denotes the entire block of channel coding & multiplexing chains 101 to 10N for receiving N encoded data that may have different qualities of service (QoS) in parallel. Here, data outputted from a coder corresponding to one channel coding & multiplexing chain has the same QoS.

The channel coding & multiplexing chains 101 to 10N each receives coded frame data from a corresponding coder. Here, respective symbol data outputted from the coders have different frame sizes and transmission periods according to their corresponding QoSs. The QoSs may be a voice, data and images. Accordingly, a communicated information frame may be differently constructed according to its QoS. Here, a frame size and a frame transmission period represent the bit number per a frame and a frame transmission time, respectively. In the embodiment of the present invention, it is assumed that the frame transmission period is 10, 20, 40, or 80msec. According to its service type, input coded data may have a different frame size and frame transmission period.

Each of first interleavers 111 to 11N primarily interleaves received frame information. Radio frame generators 121 to 12N segment the frame information received from the first interleavers 111 to 11N into radio frames R_1 to R_N as indicated by reference numeral ① in FIG. 3, and output the radio frames R_1 to R_N sequentially in the order of segmentation. Here, the radio frames R_1 to R_N have the same transmission period irrespective of transmission periods outputted from the coders. The radio frame transmission period is assumed to be 10ms in the embodiment of the present invention. If Li/Ti (Li: the whole size of an input frame and Ti: a transmission period variable) is not an integer, a filler bit is inserted. The filler bit is pre-processed prior to radio frame segmentation in order to maintain a radio frame size constant for a transmission period. A transmission size of the whole frames is easily controlled by keeping a radio frame size constant within the transmission period. When a transport channel frame has the maximum transmission period of 80msec, seven filler bits can be used at maximum. The decrease of transmission efficiency that arises from an increase in the whole data frame rate caused by addition of these filler bits is negligibly small. Details will be described in the following bit processing step. The radio frame generators 121 to 12N sequentially segment input frames into 10-msec radio frames R_1 to R_N. The rate matchers 131 to 13N adjust the data rates of the radio frames R_1 to R_N received from the radio frame generators 121 to 12N and output data frames K_1 to K_N.

Then, a second multiplexer 200 multiplexes the data frames K_1 to K_N received from the rate matchers 131 to 13N to a serial data stream of size P as indicated by reference numeral ② in FIG. 3. Here, the second multiplexer 200 can sequentially multiplex the data frames K_1 to K_N. In this case, the size of the multiplexed frame P =

$K_1 + K_2 + \ldots + K_N$.

A physical channel generator 300 segments the multiplexed frame of size P received from the second multiplexer 200 into M physical channel frames as indicated by ③ in FIG. 3 (M is the number of available physical channels) and feeds the physical channel frames to second interleavers 401 to 40N. Here, each physical channel frame is as long as P/M.

Regarding the structure of a uplink channel transmitting device shown in FIG. 1, frame-basis bits outputted from the first interleavers 111 to 11N are respectively inputted to the corresponding radio frame generators 121 to 12N. Here, the frame transmission period can be 10, 20, 40, or 80msec, and the radio frame generators 121 to 12N sequentially segment input frames into 10-msec radio frames R_1 to R_N. If Li/Ti (Li: the whole size of an input frame and Ti: a transmission period variable) is not an integer, a filler bit is inserted. The filler bit is pre-processed prior to radio frame segmentation in order to maintain a radio frame size constant for a transmission period. A transmission size of the whole frames is easily controlled by keeping a radio frame size constant within the transmission period. When a transport channel frame has the maximum transmission period of 80msec, seven filler bits can be used at maximum. The decrease of transmission efficiency that arises from an increase in the whole data frame rate caused by addition of these filler bits is negligibly small. Therefore, all the operations after the radio frame generator 121 to 12 N are performed on the basis of 10-msec, a radio frame unit. 10-msec frames outputted from the radio frame generator 121 to 12N are inputted to the second multiplexer 200 through corresponding rate matcher 131 to 13N.

The second multiplexer 200 has several parallel input, which have different QoS's. The second multiplexer 200 sequentially arranges 10-msec frames transmitted from respective QoS stages and generates a multiplexed frame of size P. The physical channel gemerator 300 sequentially divides the multiplexed frame of size P outputted from the second multiplexer 200 into frames of a physical channel number, and outputs the divided frames to corresponding physical channels in parallel.

An uplink channel receiving device for receiving radio frames from the uplink channel transmitting device performs the operation of the uplink channel transmitting device in the reverse order. Frames are inputted in parallel from each physical channel to

a physical channel frame assembler, and an output of the physical channel frame assembler is inputted to a second demultiplexer. The second demultiplexer outputs its input in parallel through each rate dematching. Rate dematched 10-msec blocks are inputted to a first deinterleaver at a corresponding transmission period through a radio frame assembler.

The operation of each component shown in FIG. 1 is illustrated in FIG. 3 in detail.

Referring to FIG. 3, reference numeral ① denotes that a radio frame generator segments input frames the first interleavers 111 to 11N into radio frames with the same frame period. If Li/Ti (Li is the size of a transport channel frame and Ti is the number of segments corresponding to the radio frame transmission period) is not an integer, a corresponding radio frame generator inserts a filler bit to make Li be a multiple of Ti. As shown in FIG. 3, filler bits are sequentially inserted into radio frames, preferably beginning with the last radio frame. In FIG. 3, RFi, BTi indicate a t^{th} radio frame block in an i^{th} radio frame generator. Filler bits are added to an RF(BTi−ri+1)−1 block through an RF(BTi)−1 block. The embodiment of the present invention is described in the context with the case that one filler bit 0 or 1 is inserted into one radio frame. Reference numeral ② indicates rate matching of the radio frames according to their data rates, multiplexing of N radio frames of size K_i (I = 1, 2, ..., N) after rate matching to one multiplexed frame of size P, and transmission of the multiplexed frame to the physical channel frame generator. Reference numeral ③ indicates segmentation of the multiplexed frame into M physical channel frames and parallel assignment of the M physical channel frames to physical channels.

FIG. 2 is a block diagram of a downlink channel transmitting device for downlink channel coding & multiplexing, illustrating a first interleaver through a second interleaver.

The downlink channel transmitting device operates in the same manner as the uplink channel transmitting device shown in FIGS. 1 and 3 except that the outputs of radio frame generators are applied to the input of the second multiplexer. Rate matchers are not shown in the drawing because they are disposed before the first interleavers in the downlink channel transmitting device of FIG. 2.

A downlink channel receiving device is the same in operation as the uplink channel receiving device except that it does not perform rate dematching.

A description will be given primarily of the radio frame generators 121 to 12N, a second multiplexer 200, and a physical channel generator 300 in the channel transmitting devices constituted as shown in FIGS. 1 and 2 according to the embodiment of the present invention.

(Radio Frame Generation Using Filler Bit)

First, a description will be given of an operation of the radio frame generator.

Uplink and downlink radio frame generators operate in the same manner. The radio frame generators 121 to 12N segment input frames into 10-msec radio frame blocks and sequentially output the radio frames at every 10msec intervals.

In case the ratio (Li/Ti) of the size of a transport channel frame applied to the input of a radio frame generator to the radio frame transmission period is not an integer, the number ri of filler bits is calculated in the following way in order to make Li/Ti an integer. Since Ti ranges from 0 to 8, ri ranges from 0 to 7. (Li+ri)/Ti achieved with the use of filler bits is defined as Ki and Ri, respectively for the downlink and the uplink.

$$ri = Ti - (Li \bmod Ti), \text{ here } ri = \{0, 1, 2, 3, 4, 5, 6, 7\}$$
$$\text{downlink} : Ki = (Li+ri)/Ti$$
$$\text{uplink} : Ri = (Li+ri)/Ti$$

If the number ri of filler bits is not 0, a filler bit is added to the last bit position of each of corresponding radio frames from a $(Ti-ri+1)^{th}$ radio frame in order to maintain a frame size constant, i.e., Ki or Ri. 0 or 1 is arbitrarily selected as a filler bit. The filler bit has little to do with performance and serves as a reserved bit that can be selected by a system user. It can be contemplated that the filler bit is designated as a discontinuous transmission (DTX) bit so that a transmitter does not transmit the filler bit after channel coding & multiplexing. The radio frame blocks that are modified to have a constant radio frame size in the above manner are fed to the second multiplexer. Then, the operation of the radio frame generators on a bit basis will be described in detail.

As for bits prior to radio frame segmentation in an i^{th} channel coding & multiplexing chain, it is assumed that the number ri of filler bits has already been calculated and $1 \leq t \leq Ti$ (t indicates a radio frame index). t=1 for the first radio frame, t=2 for the second radio frame, and t=Ti for the last radio frame. Each radio frame has the same size, (Li+ri)/Ti. Then, let the output bits of a first interleaver of the i^{th} channel coding & multiplexing chain be b_{i1}, b_{i2}, ..., b_{iLi} and let the output bits of the radio frame generator be c_{i1}, c_{i2}, ..., $c_{i,(Li+ri)/Ti}$ in 10-msec frame units for Ti = transmission period (msec) of an i^{th} radio frame matcher/10 (msec) $\in \{1, 2, 4, 8\}$. Then

output bits of the radio frame generator for the first 10msec: t = 1

$c_{ij} = b_{ij}$, $j = 1, 2, ..., (L_i+r_i)/T_i$

output bits of the radio frame generator for the second 10msec: t = 2

$c_{ij} = b_{i.(j+(Li+ri)/Ti))}$, $j = 1, 2, ..., (L_i+r_i)/T_i$

output bits of the radio frame generator for the $(T_i-r_i)^{th}$ 10msec: $t = (T_i-r_i)$

$c_{ij} = b_{i,(j+(Ti-ri-1)(Li+ri)/Ti))}$, $j = 1, 2, ..., (L_i+r_i)/T_i$

output bits of the radio frame generator for the $(T_i-r_i+1)^{th}$ 10msec: $t = (T_i-r_i+1)$

$c_{ij} = b_{i,.(j+(Ti-ri)(Li+ri)/Ti))}$, $j = 1, 2, ..., (L_i+r_i)/T_i$

c_{ij} = filler _bit (0/1), $j = (L_i+r_i)/T_i$

:

:

output bits of the radio frame generator for the T_i^{th} 10msec: $t = T_i$

$c_{ij} = b_{i,.(j+(Ti-ri)(Li+ri)/Ti))}$, $j = 1, 2, ..., (L_i+r_i)/T_i$

c_{ij} = filler _bit (0/1), $j = (L_i+r_i)/T_i$

The radio frame generator is included in a transmitting device and its counterpart is a radio frame assembler in a receiving device. Radio frame desegmentation is equivalent to the reverse operation of radio frame segmentation in that 10-msec blocks received for a transmission period are sequentially arranged and assembled into one frame.

FIG. 5 illustrates a radio frame generation process using filler bits in the above-described manner. Variables as used below will first be defined.

t: frame time index (1, 2, ..., Ti);

Ri, t: a t^{th} 10msec radio frame in an i^{th} radio frame matcher; and

Li: input frame size from the i^{th} radio frame matcher.

Referring to FIG. 5, the radio frame generator performs an initialization process in step 511:

t: =1 /*frame time index initialization*/

ri: =Ti – L mod Ti /* number of filler bits*/

Ri: = (Li+ri)/Ti for UL (uplink) /*radio frame size for uplink*/

Ki: = (Li+ri)/Ti for DL (downlink) /* radio frame size for downlink*/

In step 513, the radio frame generator checks whether the number ri of filler bits is 0. If the number ri of filler bits is 0, the radio frame generator reads data of a radio frame size from an input frame and stores it in step 517. On the other hand, if the number ri of filler bits is not 0, the radio frame generator checks whether a frame index t is (Ti–ti+1) in step 515, that is, a current radio frame is to be added with a filler bit. In the case of a radio frame that will not be added with a filler bit, the radio frame generator reads data of a radio frame size from an input frame and stores it in step 519 and proceeds to step 525. In the case of a radio frame that will be added with a filler bit, the radio frame generator reads data one bit smaller than a radio frame size from the input frame and stores it in step 521. The radio frame generator inserts the last bit position of the stored radio frame in step 523, increases the frame index t by 1 in step 525, and checks whether the updated frame index t is larger than the segment number Ti corresponding to the radio frame transmission period in step 527. If the frame index t is smaller than the segment number Ti corresponding to the radio frame transmission period, the radio frame generator returns to step 513. If the frame index t is larger than the segment number Ti corresponding to the radio frame transmission period, the radio frame generation procedure ends. Radio frames generated in this manner are sequentially fed to the second multiplexer 200.

(Radio Frame Generation Without Inserting Filler Bits)

A radio frame generator that does not use filler bits may be used instead of the above described radio frame generator. Since Ti ranges from 0 to 8, ri ranges from 0 to 7. (Li+ri)/Ti for the downlink and the uplink are defined as Ki and Ri, respectively.

ri = Ti – (Li mod Ti), here ri = {(0, 1, 2, 3, 4, 5, 6, 7}

downlink: Ki = (Li+ri)/Ti

uplink: Ri = (Li+ri)/Ti

The bit-basis operation of the radio frame generator that does not use filler bits will be described in detail.

As for bits prior to radio frame segmentation in the i^{th} channel coding & multiplexing chain, it is assumed that the number ri of filler bits has already been calculated and $1 \leq t \leq Ti$ (t indicates a radio frame index). t=1 for the first radio frame, t=2 for the second radio frame, and t=Ti for the last radio frame.

Then, let the output bits of the first interleaver in the i^{th} channel coding & multiplexing chain be $b_{i1}, b_{i2}, \ldots, b_{iLi}$ and let the output bits of the radio frame generator be $c_{i1}, c_{i2}, \ldots, c_{i,(Li+ri)/Ti}$ in a 10-msec frame unit for Ti = transmission period (msec) of the i^{th} channel coding & multiplexing chain/10 (msec) $\in \{1, 2, 4, 8\}$. Then

output bits of the radio frame generator for the first 10msec: t = 1
$c_{ij} = b_{ij}, \quad j = 1, 2, \ldots, (L_i+r_i)/T_i$
output bits of the radio frame generator for the second 10msec: t = 2
$c_{ij} = b_{i.(j+(Li+ri)/Ti))}, \quad j = 1, 2, \ldots, (L_i+r_i)/T_i$
output bits of the radio frame generator for the $(T_i-r_i)^{th}$ 10msec: $t = (T_i-r_i)$
$c_{ij} = b_{i,(j+(Ti-ri-1)(Li+ri)/Ti))}, \quad j = 1, 2, \ldots, (L_i+r_i)/T_i$
output bits of the radio frame generator for the $(T_i-r_i+1)^{th}$ 10msec: $t = (T_i-r_i+1)$
$c_{ij} = b_{i,.(j+(Ti-ri)(Li+ri)/Ti))}, \quad j = 1, 2, \ldots, (L_i+r_i)/T_i$
:
:
output bits of the radio frame generator for the T_i^{th} 10msec: $t = T_i$
$c_{ij} = b_{i,.(j+(Ti-ri)(Li+ri)/Ti))}, \quad j = 1, 2, \ldots, (L_i+r_i)/T_i$

If ri is not 0, the size of the first to $(Ti-ri)^{th}$ radio frames is Ki or Ri and the size of the $(Ti-ri+1)^{th}$ to the last radio frames is (Ki−1) or (Ri−1). Radio frame blocks of sizes varied with time are fed to the multiplexer. Due to the variable radio frame size, a frame size in the multiplexer may vary at every 10msec intervals and the physical channel generator may also operate differently at every 10msec intervals, making control of frame size complicated. Accordingly, it is preferable to employ a radio frame generator which inserts filler bits.

The radio frame generator is included in a transmitting device and its

counterpart is a radio frame assembler in a receiving device. Radio frame desegmentation is equivalent to the reverse operation of radio frame segmentation in that 10-msec blocks received for a transmission period are sequentially arranged and assembled into one frame..

FIG. 6 illustrates a radio frame generation process using filler bits in the above-described manner. Variables as used hereinbelow will first be defined.

t: frame time index (1, 2, ..., Ti);

Ri, t: a t^{th} 10msec radio frame in an i^{th} channel coding & multiplexing chain; and

Li: input frame size from the i^{th} channel coding & multiplexing chain.

Referring to FIG. 6, the radio frame generator performs an initialization process in step 611:

t: =1 /*frame time index initialization*/

ri: =Ti – L mod Ti /* number of filler bits*/

Ri: = (Li+ri)/Ti for UL (uplink) /*radio frame size for uplink*/

Ki: = (Li+ri)/Ti for DL (downlink) /* radio frame size for downlink*/

In step 613, the radio frame generator checks whether the number ri of filler bits is 0. If the number ri of filler bits is 0, the radio frame generator reads data of a radio frame size from an input frame and stores it in step 617. On the other hand, if the number ri of filler bits is not 0, the radio frame generator checks whether a frame index t is (Ti–ti+1) in step 615. If the frame index t is smaller than (Ti–ti+1), the radio frame generator reads data of a radio frame size from an input frame and stores it in step 619 and proceeds to step 623. If the frame index t is equal to or greater than (Ti–ti+1), the radio frame generator reads data one bit smaller than a radio frame size from the input frame and stores it in step 621. The radio frame generator increases the frame index t by 1 in step 623, and checks whether the updated frame index t is larger than the segment number Ti corresponding to the radio frame transmission period in step 625. If the frame index t is smaller than the segment number Ti corresponding to the radio frame transmission period, the radio frame generator returns to step 613. If the frame index t is greater than the segment number Ti corresponding to the radio frame transmission period, the radio frame generation procedure ends. Radio frames generated in this manner are sequentially fed to the second multiplexer 200.

(Second Multiplexing)

Second, an operation of the second multiplexer 200 will be hereinbelow described.

First, an operation of a second multiplexer for the uplink will be described below.

Bits as described below are applied to the input of the second multiplexer.

output bits of rate matcher #1: $c_{11}, c_{12}, \ldots, c_{1K1}$
output bits of rate matcher #2: $c_{21}, c_{22}, \ldots, c_{2K2}$
output bits of rate matcher #3: $c_{31}, c_{32}, \ldots, c_{3K3}$
...
output bits of rate matcher #N: $c_{N1}, c_{N2}, \ldots, c_{NKN}$

The output bits $d_1, d_2, \ldots, d_p$ of the second multiplexer are

when $j = 1, 2, 3, \ldots, P$ $(P = K_1+K_2+\ldots+K_N)$,

$d_j = c_{ij}$ $\quad j = 1, 2, \ldots, K_1$
$d_j = c_{2(j-K1)}$ $\quad j = K_1+1, K_1+2, \ldots, K_1+K_2$
$d_j = c_{3(j-(K1+K2))}$ $\quad j = (K_1+K_2)+1, (K_1+K_2)+2, \ldots, (K_1+K_2)+K_3$
...
$d_j = c_{N(j-(K1+K2+\ldots+KN-1))}$ $\quad j = (K_1+K_2+\ldots+K_{N-1})+1, (K_1+K_2+\ldots+K_{N-1})+2, \ldots, (K_1+K_2+\ldots+K_{N-1})+K_N$

Second, the operation of a second multiplexer for the downlink will be described below.

Bits as described below are applied to the input of the second multiplexer.

output bits of rate matcher #1: $c_{11}, c_{12}, \ldots, c_{1K1}$
output bits of rate matcher #2: $c_{21}, c_{22}, \ldots, c_{2K2}$
output bits of rate matcher #3: $c_{31}, c_{32}, \ldots, c_{3K3}$
...
output bits of rate matcher #N: $c_{N1}, c_{N2}, \ldots, c_{NKN}$

The output bits $d_1, d_2, ..., d_p$ of the second multiplexer 200 are

when $j = 1, 2, 3, ..., P$ ($P = K_1+K_2+...+K_N$),

$d_j = c_{ij}$ $\quad j = 1, 2, ..., K_1$

$d_j = c_{2(j-K1)}$ $\quad j = K_1+1, K_1+2, ..., K_1+K_2$

$d_j = c_{3(j-(K1+K2))}$ $\quad j = (K_1+K_2)+1, (K_1+K_2)+2, ..., (K_1+K_2)+K_3$

. . .

$d_j = c_{N(j-(K1+K2+...+KN-1))}$ $\quad j = (K_1+K_2+ . . . +K_{N-1})+1, (K_1+K_2+ . . . +K_{N-1})+2, ..., (K_1+K_2+ . . . +K_{N-1})+K_N$

The second multiplexer is included in a transmitting device and its counterpart is a second demultiplexer in a receiving device. The demultiplexer reversely performs the operation of the second multiplexer, that is, segments an input frame into N blocks and feeds the N blocks to corresponding radio frame dematchers.

FIG. 7 is a flowchart illustrating a radio frame multiplexing procedure in the second multiplexer. Prior to description of the procedure shown in FIG. 7, terms as used below are defined.

N: total number of radio frame matchers;
i: radio frame matcher index (1, 2, ..., N); and
Rfi: a 10msec radio frame in an i^{th} radio frame matcher.

The second multiplexer sets a multiplexing chain index i to an initial value 1 in step 711 and stores a radio frame received from the i^{th} radio frame matcher in a second multiplexing buffer in step 713. In step 715, the second multiplexer increases the multiplexing index i by 1. Then, the second multiplexer checks whether the increased index i is greater than the total number N of multiplexing chains in step 717. If i is equal to or smaller than N, the second multiplexer returns to step 713. If i is greater than N, the second multiplexer ends the multiplexing procedure. As described above, the second multiplexer sequentially stores radio frames received from the radio frame matchers in the multiplexing buffer and generates a multiplexed frame of size P that is a serial data frame.

(Physical Channel Frame Generation)

Third, an operation of a physical channel frame generator 300 will be hereinbelow described.

The physical channel frame generator 300 operates in the same manner for the uplink and the downlink.

Let the bit of a serial data frame output from the multiplexer be $d_1, d_2, ..., d_p$, and the number of physical channels be M. Then,

output bits of the physical channel frame generator for physical channel #1:
$e_{1j} = d_j$ $\quad j = 1, 2, ..., P/M$
output bits of the physical channel frame generator for physical channel #2:
$e_{2j} = d_{(j+P/M)}$ $\quad j = 1, 2, ..., P/M$
output bits of the physical channel frame generator for physical channel #M:
$e_{Mj} = d_{(j+(M-1)P/M)}$ $\quad j = 1, 2, ..., P/M$

The above physical channel segmentation scheme in the physical channel generator is advantageous in that the best use of the effects of the second interleavers are made. Therefore, the probability of bit errors after decoding at a receiver, caused by burst error on a fading channel, can be minimized. For a data rate of 1/3 for a general channel coder, three symbols represent one information bit. Another physical channel segmentation scheme with M=3 and P=30 can be further contemplated as shown below

Bits before physical channel segmentation
0 1 2 3 4 5 6 7 8 9 10 . . . 29
Bits after physical channel segmentation
Physical channel #1: 0 3 6 9 12 . . . 27
Physical channel #2: 1 4 7 10 13 . . . 28
Physical channel #3: 2 5 8 11 14 . . . 29

Since the same second interleaver is used in this three-physical channel segmentation, three input symbols are always consecutive after second interleaving. Accordingly, the three consecutive symbols are highly likely to experience errors at fading at a specific time point.

Meanwhile, a segment having consecutive bits of the same number is assigned

to one physical channel in the present invention and thus

Bits before physical channel segmentation
0 1 2 3 4 5 6 7 8 9 10 . . . 29
Bits after physical channel segmentation
Physical channel #1: 0 1 2 3 . . . 9
Physical channel #2: 10 11 12 13 . . . 29
Physical channel #3: 20 21 22 23 . . . 29

After second interleaving, three physical channels have different time in the same bit position, thereby decreasing the probability of concurrent errors in three symbols representative of one information bit due to fading. Therefore, a receiver may have a lower bit error rate (BER) in the present invention than the above-described physical channel segmentation.

The physical channel frame generator is included in a transmitting device and its counterpart is a physical channel assembler in a receiving device. The physical channel assembler performs the reverse operation of the physical channel generator, that is, sequentially arranges M physical channel frames and assembles them into one frame.

FIG. 8 is a flowchart illustrating a physical channel frame generating procedure in the physical channel generator. Terms as used below will first be defined.

m: physical channel index (1, 2, ..., M);
M: total number of physical channels; and
P: index data block size in bits.

Referring to FIG. 8, the physical channel generator 300 sets the physical channel index m to an initial value 1 in step 811 and reads a data block of size p/m from input data of size p and stores it in an m^{th} physical channel buffer in step 813. Then, the physical channel generator 300 increases the physical channel index m by 1 in step 815 and checks whether the increased physical channel index m is greater than the total number M of the physical channels in step 817. If m is equal to or smaller than M, the physical channel generator 300 returns to step 813. On the contrary, if m is greater than M, the physical channel segmentation ends.

(Implementation of Receiving device)

FIG. 4 is a block diagram of a channel receiving device having the counterparts of the radio frame generator, the multiplexer, and the physical channel generator as described above. Referring to FIG. 4, a physical channel memory 411 stores second-interleaved symbols. A first address generator 412 generates a write address for every M bits of the second-interleaved symbols at which the M bits will be stored in the physical channel memory 411. A second address generator 413 generates a read address for sequentially reading the symbols from the physical channel memory 411 when the symbols are completely stored in the physical channel memory 411. A demultiplexer 414 distributes symbols received from the physical channel memory 411 to N buffers 415 to 4N5. The buffers 415 to 4N5 feed the stored symbols to corresponding radio assemblers 417 to 4N7 without rate dematching if the symbols are for the downlink and to rate dematchers 416 to 4N6 if the symbols are for the uplink. The rate dematchers 416 to 4N6 perform zero symbol insertion and symbol combination, in the reverse order of rate matching. The radio frame assemblers 417 to 4N7 assemble the symbols received from the rate dematchers 416 to 41N to data of corresponding transport channel transmission periods and transmit the desegmented data to a channel decoder for channel decoding.

For a write operation, the first address generator 412 operates to write every M bits in the physical channel memory 411, that is a buffer memory for storing symbols received after second deinterleaving. Therefore, the physical channel memory 411 receives a total of P symbols from the second interleaver by operating P/M times. When there is no data on each channel coding & multiplexing channel, the total number of received symbols is smaller than P. Hence, a maximum buffer size is P. Upon completion of the write operation, the second address generator 413 generates read addresses and symbols are read from the physical channel memory 411 in the address generation order. The read operation is performed in (Li+ri)/Ti (=Ri) units. By reading N frames of size Ri, a total of P symbols are transmitted to the N buffers 415 to 4N5 through the demultiplexer 414. Each buffer has a size of Ti x Ri (i = 1, 2, 3, ..., N). In this course, the demultiplexer 414 serves to distinguish N symbols. The classified symbols are transmitted directly to the radio frame assemblers 417 to 4N7 without rate dematching if they are the downlink ones, whereas the symbols are subjected to rate dematching if they are the uplink ones. That is, the rate dematchers 416 to 4N6 implements zero symbol insertion and symbol combination, which is the reverse operation of rate matching. Then, the radio frame assemblers 417 to 4N7 transmit

desegmented symbols to corresponding channel decoders for channel decoding. As noted from the above description, the operation of the receiving device is basically the reverse of that of the transmitting device.

[EFFECTS OF THE INVENTION]

In accordance with the present invention as described above, radio frame generation, second multiplexing, and physical channel frame generation for multiplexing & channel coding are defined in detail. Frames of various types generated from channel coders are converted to radio frames, multiplexed, and converted to physical frames. The physical frames are then assigned to physical channels. Therefore, uplink and downlink transmitting devices in a CDMA communication system can implement various communication services such as transmission of voice, data, and images.

[PATENT CLAIMS]

1. A channel transmitting device in a CDMA communication system, the device comprising:

two or more coders for generating coding data having different frame sizes and transmission periods;

radio frame generators for dividing a frame outputted from the coders into a plurality of radio frames having a same frame transmission period;

a multiplexer for sequentially storing the radio frames outputted from the radio frame generators and generating a multiplexing frame; and

a physical channel frame generator for generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

2. The channel transmitting device as claimed in claim 1, wherein the radio frame generator determines the number of filler bits for dividing the frame transmitted from the coder into the same size of parts and equally distributes the filler bits to the divided radio frames.

3. The channel transmitting device as claimed in claim 1, further comprising a first interleaver for interleaving the coding data transmitted from the coder and outputting the interleaved coding data to the radio frame generator.

4. The channel transmitting device as claimed in claim 1, further comprising a rate matcher for rate matching the radio frame from the radio frame generator in accordance with a data rate.

5. The channel transmitting device as claimed in claim 1, wherein the radio frame has a frame transmission period of 10msec.

6. The channel transmitting device as claimed in claim 2, wherein the radio frame generator determines the number of the filler bits through Equation 1 below.

[Equation 1]

$ri = Ti - (Li \bmod Ti)$

where 'ri', 'Ti', and 'Li' represent the number of the filler bits, the division

number according to the transmission period, and the size of a frame outputted from the coder, respectively.

7. The channel transmitting device as claimed in claim 2, wherein the filler bit is not transmitted.

8. The channel transmitting device as claimed in claim 1, wherein the physical channel frame generator generates the physical channel frame by assigning a continuous bit segment of the same bit number regarding each physical channel.

9. The channel transmitting device as claimed in claim 1, wherein the physical channel frame generator includes a second interleaver for interleaving the generated physical channel frame.

10. A channel receiving device in a CDMA communication system, the device comprising:

two or more physical channel receivers for storing a received physical channel frame in each corresponding area of a buffer;

a demultiplexer for accessing the physical channel frames stored in the respective areas of the buffer to generate a multiplexing frame and demultiplexing the multiplexing frame to separate the frame into radio frames;

demultiplexing chains each for assembling the separated radio frame into a coding frame; and

decoders for decoding a coding frame respectively transmitted to a corresponding demultiplexing chain, wherein the number of the decoders is equal to the number of the demultiplexing chains.

11. The channel receiving device as claimed in claim 10, further comprising a second deinterleaver for deinterleaving the received physical channel frame to output the deinterleaved physical channel frame to each corresponding area of the buffer.

12. The channel receiving device as claimed in claim 10, wherein the demultiplexing chain comprises:

a radio frame assembler for assembling radio frames transmitted from the demultiplexer into one frame suitable to a transmission period; and

a first deinterleaver for deinterleaving the frame from the radio frame assembler to output the deinterleaved frame to the decoder.

13. The channel receiving device as claimed in claim 10, further comprising a rate dematcher for rate dematching radio frames from the demultiplexing chain in accordance with a data rate.

14. The channel receiving device as claimed in claim 10, wherein the radio frame has a frame transmission period of 10msec.

15. A channel transmitting method in a CDMA communication system, the method comprising the steps of:

generating, in two or more coders, coding data having different frame sizes and transmission periods;

dividing, in radio frame generators, a frame outputted from the coders into a plurality of radio frames having a same frame transmission period;

sequentially storing, in a multiplexer, the radio frames outputted from the radio frame generators and generating a multiplexing frame; and

generating, in a physical channel frame generator, a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

16. The channel transmitting method as claimed in claim 15, wherein the step of generating the radio frame comprises the steps of:

determining the number of filler bits according to a size and transmission period of a frame transmitted from the coder;

dividing a frame transmitted from the coder into radio frames having a same transmission period;

determining whether the divided radio frame is a filler bit requiring frame;

if the divided radio frame is not a filler bit requiring frame, dividing the divided radio frame by a first size to generate a radio frame; and

if the divided radio frame is a filler bit requiring frame, dividing the divide frame by a second size smaller than the firs[illegible] ;erating a radio frame by adding the filler bit to the divided data block.

17. The channel transmitting method as claimed in claim 16, wherein the

number of the filler bits is calculated through Equation 2 below.

[Equation 2]

ri =Ti – (Li mod Ti)

where 'ri', 'Ti', and 'Li' represent the number of the filler bits, the division number according to the transmission period, and the size of a frame outputted from the coder, respectively.

18. The channel transmitting method as claimed in claim 15, wherein the multiplexing step comprises the steps of:

sequentially accessing the multiplexing chains and sequentially storing radio frames transmitted from the multiplexing chains; and

upon completion of the radio frame storing step, assembling the stored radio frames into a multiplexing frame and outputting the assembled frame to the physical channel frame generator.

19. The channel transmitting method as claimed in claim 15, wherein the step of generating a physical channel frame comprises the steps of:

storing a multiplexing frame transmitted from the multiplexer;

sequentially dividing the multiplexing frame by the number of physical channels; and

storing a data block divided from the multiplexing frame in a corresponding physical channel buffer.

20. The channel transmitting method as claimed in claim 15, wherein the step of generating the radio frame comprises the steps of:

determining the number of filler bits according to a size and transmission period of a frame transmitted from the coder;

dividing a frame transmitted from the coder into radio frames having a same transmission period;

determining whether the divided radio frame is a filler bit requiring frame;

if the divided radio frame is a filler bit requiring frame, dividing the divided radio frame by a first size to generate a radio frame; and

if the divided radio frame is not a filler bit requiring frame, dividing the divide frame by a second size smaller than the first size and generating a radio frame.

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

There is provided a channel communication device in a CDMA communication system. The channel communication device comprises: two or more coders for generating coding data having different frame sizes and transmission periods; radio frame generators for dividing a frame outputted from the coders into a plurality of radio frames having a same frame transmission period; a multiplexer for sequentially storing the radio frames outputted from the radio frame generators and generating a multiplexing frame; and a physical channel frame generator for generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

[REPRESENTATIVE FIGURE]

FIG. 1

[INDEX]

CDMA, communication, radio, frame, radio frame, radio frame segmentation, multiplexing, physical channel, physical channel segmentation, physical channel frame, QoS, 3GPP, UMTS, channel, channel coding, IMT2000, interleaving, interleaver, 2nd interleaver, rate, rate matching, downlink, uplink

[SPECIFICATION]

[TITLE OF THE INVENTION]

APPARATUS AND METHOD FOR CHANNEL CODING AND MULTIPLEXING IN CDMA COMMUNICATION SYSTEM

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a block diagram of an embodiment of an uplink channel transmitting device according to the present invention.

FIG. 2 is a block diagram of an embodiment of a downlink channel transmitting device according to the present invention.

FIG. 3 is a view illustrating the operation of the channel transmitting devices shown in FIGS. 1 and 2.

[DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT]

[OBJECT OF THE INVENTION]

[RELATED FIELD AND PRIOR ART OF THE INVENTION]

The present invention relates generally to a channel communication apparatus and method in a mobile communication system, and in particular, to a device and method for generating and transmitting a frame.

A conventional CDMA (Code Division Multiple Access) mobile communication system primarily provides a voice service. However, the future CDMA mobile communication system will support the IMT-2000 standard, which can provide a high-speed data service as well as the voice service. More specifically, the IMT-200 standard can provide a high-quality voice service, a moving picture service, an Internet browsing service, etc. This CDMA communication system is comprised of a downlink for transmitting data from a base station to a mobile station and an uplink for transmitting data from the mobile station to the base station.

The future CDMA communication system should provide various communication services such as simultaneous voice and data communications. However, details are yet to be specified for the simultaneous implementation of voice and data communications.

[SUBSTANTIAL MATTER OF THE INVENTION]

It is, therefore, an object of the present invention to provide a channel communication apparatus and method, which can simultaneously perform various communication services in a CDMA communication system.

It is another object of the present invention to provide an apparatus and method for generating a radio frame and a physical channel frame when performing 3GPP multiplexing and channel coding operations in a CDMA communication system.

It is further another object of the present invention to provide an apparatus and method for multiplexing a generated frame when performing 3GPP multiplexing and channel coding operations in a CDMA communication system.

It is still another object of the present invention to provide an uplink channel communication apparatus and method in a CDMA communication system, which can perform various communication functions.

It is yet another object of the present invention to provide a downlink channel communication apparatus and method in a CDMA communication system, which can perform various communication functions.

[CONSTRUCTION AND OPERATION OF THE INVENTION]

The present invention defines in detail radio frame segmentation, second multiplexing, and physical channel segmentation for 3GPP channel coding & multiplexing in a channel communication device of a CDMA communication system. That is, radio frame segmentation, second multiplexing of radio frames, and segmentation of the multiplexed radio frames into physical channel frames, that are not provided by the 3GPP Technical Specification for Multiplexing and Channel Coding, TS 25.212, will be defined fully enough to deal with bit-basis operations.

A description will now be made of the structures and operations of 3GPP uplink and downlink channel coding and multiplexing apparatuses including a first interleaver through a second interleaver according to an embodiment of the present

invention.

FIGS. 1 is a diagram illustrating the configuration of an uplink channel transmitting device according to an embodiment of the present invention.

Referring to FIG. 1, reference numeral 100 denotes the entire block of channel coding & multiplexing chains 101 to 10N for receiving N encoded data that may have different qualities of service (QoS) in parallel. Here, data outputted from a coder corresponding to one channel coding & multiplexing chain has the same QoS.

The channel coding & multiplexing chains 101 to 10N each receives coded frame data from a corresponding coder. Here, respective symbol data outputted from the coders have different frame sizes and transmission periods according to their corresponding QoSs. The QoSs may be a voice, data and images. Accordingly, a communicated information frame may be differently constructed according to its QoS. Here, a frame size and a frame period represent the bit number per a frame and a frame time, respectively. In the embodiment of the present invention, it is assumed that the frame transmission period is 10, 20, 40, or 80msec. According to its service type, input coded data may have a different frame size and frame period.

Each of first interleavers 111 to 11N primarily interleaves received frame information. Radio frame generators 121 to 12N segment the frame information received from the first interleavers 111 to 11N into radio frames R_1 to R_N as indicated by reference numeral ① in FIG. 3, and output the radio frames R_1 to R_N sequentially in the order of segmentation. Here, the radio frames R_1 to R_N have the same transmission period irrespective of transmission periods outputted from the coders. The radio frame transmission period is assumed to be 10ms in the embodiment of the present invention. The radio frame generators 121 to 12N sequentially segment input frames into 10-msec radio frames R_1 to R_N. The rate matchers 131 to 13N adjust the data rates of the radio frames R_1 to R_N received from the radio frame generators 121 to 12N and output data frames K_1 to K_N.

Then, a second multiplexer 200 multiplexes the data frames K_1 to K_N received from the rate matchers 131 to 13N to a serial data stream of size P as indicated by reference numeral ② in FIG. 3. Here, the second multiplexer 200 can sequentially multiplex the data frames K_1 to K_N. In this case, the size of the multiplexed frame P =

$K_1 + K_2 + ... + K_N$.

A physical channel generator 300 segments the multiplexed frame of size P received from the second multiplexer 200 into M physical channel frames as indicated by ③ in FIG. 3 (M is the number of available physical channels) and feeds the physical channel frames to second interleavers 401 to 40N. Here, each physical channel frame is as long as P/M.

Regarding the structure of a uplink channel transmitting device shown in FIG. 1, frame-basis bits outputted from the first interleavers 111 to 11N are respectively inputted to the corresponding radio frame generators 121 to 12N. Here, the frame transmission period can be 10, 20, 40, or 80msec, and the radio frame generators 121 to 12N sequentially segment input frames into 10-msec radio frames R_1 to R_N. All the operations after the radio frame generator 121 to 12 N are performed on the basis of 10-msec, a radio frame unit. 10-msec frames outputted from the radio frame generator 121 to 12N are inputted to the second multiplexer 200 through corresponding rate matcher 131 to 13N.

The second multiplexer 200 has several parallel input, which have different QoS's. The second multiplexer 200 sequentially arranges 10-msec frames transmitted from respective QoS stages and generates a multiplexed frame of size P. The physical channel gemerator 300 sequentially divides the multiplexed frame of size P outputted from the second multiplexer 200 into frames of a physical channel number, and outputs the divided frames to corresponding physical channels in parallel.

The operation of each component shown in FIG. 1 is illustrated in FIG. 3 in detail.

FIG. 2 is a block diagram of a downlink channel transmitting device for downlink channel coding & multiplexing, illustrating a first interleaver through a second interleaver.

The downlink channel transmitting device operates in the same manner as the uplink channel transmitting device shown in FIGS. 1 and 3 except that the outputs of radio frame generators are applied to the input of the second multiplexer. Rate matchers are not shown in the drawing because they are disposed before the first

interleavers in the downlink channel transmitting device of FIG. 2.

A description will be given primarily of the radio frame generators 121 to 12N, a second multiplexer 200, and a physical channel generator 300 in the channel transmitting devices constituted as shown in FIGS. 1 and 2 according to the embodiment of the present invention.

First, a description will be given of an operation of the radio frame generator.

Uplink and downlink radio frame generators operate in the same manner. The radio frame generators 121 to 12N segment input frames into 10-msec radio frame blocks and sequentially output the radio frames at every 10msec intervals.

Bits prior to the radio frame generator can be described as follows.

Let the output bits of a first interleaver of the i^{th} channel coding & multiplexing chain be b_1, b_2, ..., b_L, let T be a first interleaving time interval/10-msec and let output bits from the radio frame generator be b_0, b_1, ..., $b_{L/T}$ of 10-msec, then

output bits of the radio frame generator for the first 10msec:
$c_j = b_j$, $j = 1, 2, ..., L/T$
output bits of the radio frame generator for the second 10msec:
$c_j = b_{(j+L/T))}$, $j = 1, 2, ..., L/T$
output bits of the radio frame generator for the T^{th} 10msec:
$c_j = b_{(j+(T-1)L/T)}$, $j = 1, 2, ..., L/T$

Second, an operation of the second multiplexer 200 will be hereinbelow described.

First, an operation of a second multiplexer for the uplink will be described below.

Bits as described below are applied to the input of the second multiplexer.

output bits of rate matcher in QoS #1: c_{11}, c_{12}, ..., c_{1K1}
output bits of rate matcher in QoS #2: c_{21}, c_{22}, ..., c_{2K2}

output bits of rate matcher in QoS #3: $c_{31}, c_{32}, \ldots, c_{3K3}$

...

output bits of rate matcher in QoS #N: $c_{N1}, c_{N2}, \ldots, c_{NKN}$

The output bits $d_1, d_2, \ldots, d_p$ of the second multiplexer are

when $j = 1, 2, 3, \ldots, P$ ($P = K_1+K_2+\ldots+K_N$),

$d_j = c_{ij}$ $\quad j = 1, 2, \ldots, K_1$

$d_j = c_{2(j-K1)}$ $\quad j = K_1+1, K_1+2, \ldots, K_1+K_2$

$d_j = c_{3(j-(K1+K2))}$ $\quad j = (K_1+K_2)+1, (K_1+K_2)+2, \ldots, (K_1+K_2)+K_3$

...

$d_j = c_{N(j-(K1+K2+\ldots+KN-1))}$ $\quad j = (K_1+K_2+\ldots+K_{N-1})+1, (K_1+K_2+\ldots+K_{N-1})+2, \ldots, (K_1+K_2+\ldots+K_{N-1})+K_N$

Second, the operation of a second multiplexer for the downlink will be described below.

Bits as described below are applied to the input of the second multiplexer.

output bits of rate matcher in QoS #1: $c_{11}, c_{12}, \ldots, c_{1K1}$

output bits of rate matcher in QoS #2: $c_{21}, c_{22}, \ldots, c_{2K2}$

output bits of rate matcher in QoS #3: $c_{31}, c_{32}, \ldots, c_{3K3}$

...

output bits of rate matcher in QoS #N: $c_{N1}, c_{N2}, \ldots, c_{NKN}$

The output bits $d_1, d_2, \ldots, d_p$ of the second multiplexer 200 are

when $j = 1, 2, 3, \ldots, P$ ($P = K_1+K_2+\ldots+K_N$),

$d_j = c_{ij}$ $\quad j = 1, 2, \ldots, K_1$

$d_j = c_{2(j-K1)}$ $\quad j = K_1+1, K_1+2, \ldots, K_1+K_2$

$d_j = c_{3(j-(K1+K2))}$ $\quad j = (K_1+K_2)+1, (K_1+K_2)+2, \ldots, (K_1+K_2)+K_3$

...

$d_j = c_{N(j-(K1+K2+\ldots+KN-1))}$ $\quad j = (K_1+K_2+\ldots+K_{N-1})+1, (K_1+K_2+\ldots+K_{N-1})+2, \ldots, (K_1+K_2+\ldots+K_{N-1})+K_N$

Third, an operation of a physical channel frame generator 300 will be

hereinbelow described.

The physical channel frame generator 300 operates in the same manner for the uplink and the downlink.

Let the bit of a serial data frame output from the multiplexer be d_1, d_2, ..., d_p, and the number of physical channels be M. Then,

output bits of the physical channel frame generator for physical channel #1:
$e_{1j} = d_j$ $\quad j = 1, 2, ..., P/M$
output bits of the physical channel frame generator for physical channel #2:
$e_{2j} = d_{(j+P/M)}$ $\quad j = 1, 2, ..., P/M$
output bits of the physical channel frame generator for physical channel #M:
$e_{Mj} = d_{(j+(M-1)P/M)}$ $\quad j = 1, 2, ..., P/M$

[EFFECTS OF THE INVENTION]

In accordance with the present invention as described above, radio frame generation, second multiplexing, and physical channel frame generation for multiplexing & channel coding are defined in detail. Frames of various types generated from channel coders are converted to radio frames, multiplexed, and converted to physical frames. The physical frames are then assigned to physical channels. Therefore, uplink and downlink transmitting devices in a CDMA communication system can implement various communication services such as transmission of voice, data, and images.

[PATENT CLAIMS]

1. A uplink channel communication device in a CDMA communication system, the device comprising:

two or more coders for generating coding data having different frame sizes and periods;

multiplexing chains for dividing data outputted from the coders into radio frames having a same frame period and multiplexing the divided radio frames; and

a physical channel frame generator for generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

2. A downlink channel communication device in a CDMA communication system, the device comprising:

two or more coders for generating coding data having different frame sizes and periods;

multiplexing chains for dividing data outputted from the coders into radio frames having a same frame period and multiplexing the divided radio frames; and

a physical channel frame generator for generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

3. A uplink channel data communication device in a CDMA communication system, the method comprising the steps of:

generating at least two coding data having different frame sizes and periods;

dividing data outputted from the coders into radio frames having a same frame period and multiplexing the divided radio frames; and

generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

4. A downlink channel data communication device in a CDMA communication system, the method comprising the steps of:

generating at least two coding data having different frame sizes and periods;

dividing data outputted from the coders into radio frames having a same frame period and multiplexing the divided radio frames; and

generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

There is provided a channel communication device in a CDMA communication system. The channel communication device comprises: two or more coders for generating coding data having different frame sizes and periods; multiplexing chains for dividing data outputted from the coders into radio frames having a same frame period and multiplexing the divided radio frames; and a physical channel frame generator for generating a physical channel frame by dividing the multiplexing frame by the number of physical channels and transmitting the physical channel frame to each physical channel.

[REPRESENTATIVE FIGURE]

FIG. 1

[INDEX]

radio frame, multiplexing, physical channel frame, QoS